National Weather Service's Meteorological Development Lab (MDL)
Where We Are and Where We're Going

Dr. Mike Farrar, MDL Director

Bob Glahn Symposium
AMS Annual Meeting
January 6, 2015

Outline

- MDL History

- Current MDL capabilities and short-term plans
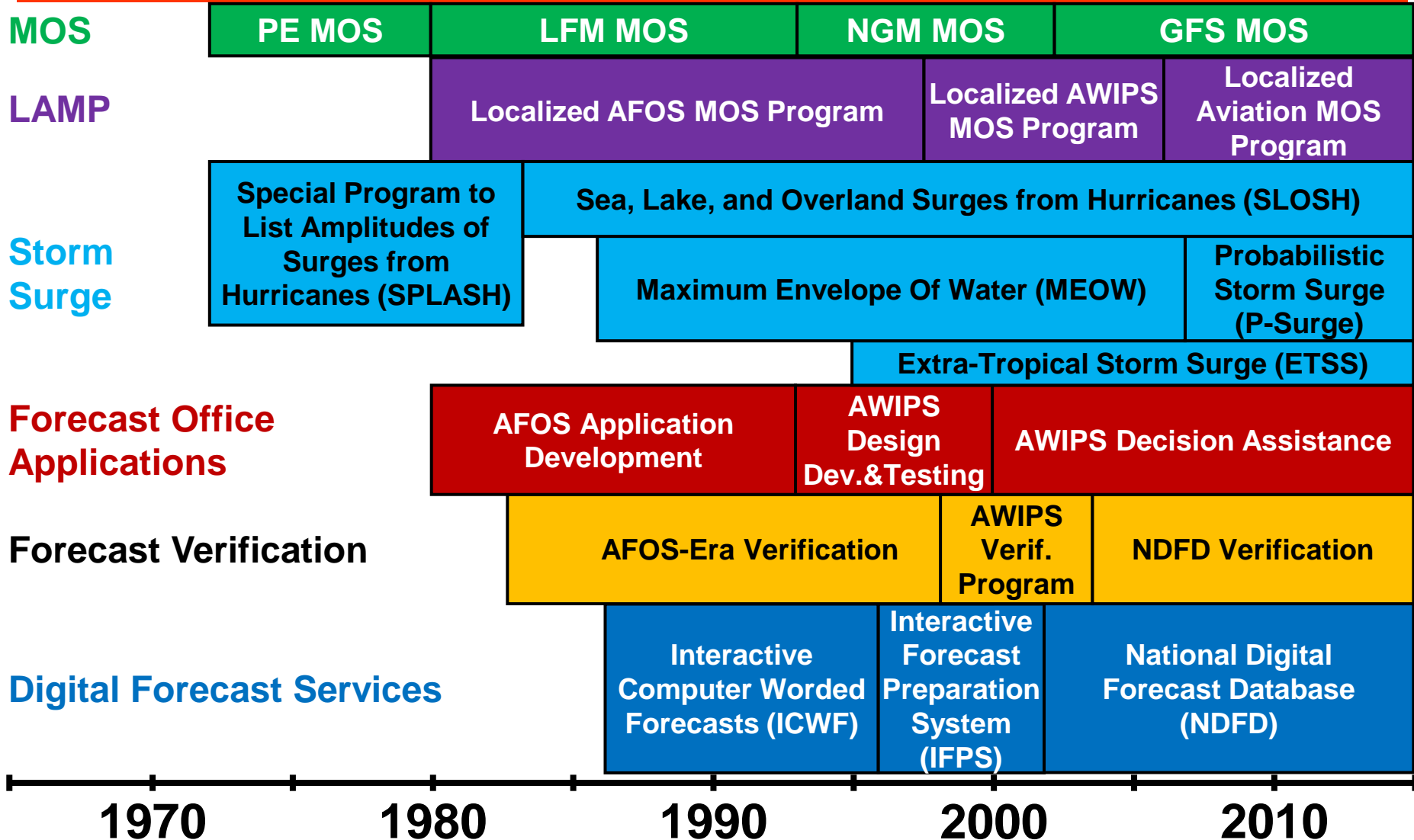
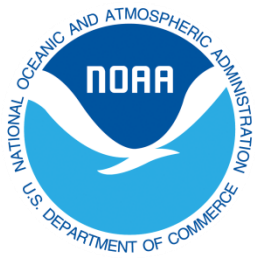- Strategic vision and long-term plans

History of MDL Milestones

1964: Techniques Development Laboratory (TDL) created

1972: Glahn and Lowry "The use of Model Output Statistics (**MOS**) in objective weather forecasting" + **Storm surge** work begins

1980: Localized AFOS MOS Program (**LAMP**) work begins

Forecast office applications work begins

1983: Forecast **verification** work begins in TDL

1984: Sea, Lake, and Overland Surges from Hurricanes (**SLOSH**)

1986: **Digital Forecast Services** work begins

1994: **AWIPS** design development and testing

2001: Name changed to Meteorological Development Laboratory (**MDL**)

2004: National Digital Forecast Database (**NDFD**)

2015: New Science and Technology Integration (**STI**) office

History of MDL Products

MOS	**PE MOS**	**LFM MOS**	**NGM MOS**	**GFS MOS**

LAMP

Localized AFOS MOS Program	Localized AWIPS MOS Program	Localized Aviation MOS Program

Storm Surge

Special Program to List Amplitudes of Surges from Hurricanes (SPLASH)	Sea, Lake, and Overland Surges from Hurricanes (SLOSH)	
	Maximum Envelope Of Water (MEOW)	Probabilistic Storm Surge (P-Surge)

Extra-Tropical Storm Surge (ETSS)

Forecast Office Applications

AFOS Application Development	AWIPS Design Dev.&Testing	AWIPS Decision Assistance

Forecast Verification

AFOS-Era Verification	AWIPS Verif. Program	NDFD Verification

Digital Forecast Services

Interactive Computer Worded Forecasts (ICWF)	Interactive Forecast Preparation System (IFPS)	National Digital Forecast Database (NDFD)

1970   1980   1990   2000   2010

4

MDL's Mission

- Develop *interpretive model guidance* and *decision support applications* in support of NWS operations

- Collaborate with NWS field developers and research organizations to *transition research to operations (R2O)*

- ***Aid the NWS forecast and warning mission to protect life and property and enhance the national economy***

MDL's Core Competencies

- Transition of R2O

- Development of digital forecast services

- Application of statistical methods to improve forecasts and services

- Verification of sensible weather forecasts and guidance

- Development of tools and applications for decision support services

- Storm surge model development

Major Activities of MDL's 4 Branches

Digital Forecast Services Branch

- National Digital Forecast Database (NDFD)
- Localized Aviation MOS Program (LAMP)
- Evaluation of forecasts and guidance

Statistical Modeling Branch

- National Blend of Models
- Model Output Statistics (MOS)
- High-quality model and observation archives

MDL

Weather Information Applications Branch

- Web services
- Metadata
- Data modeling

Decision Support Branch

- IRIS/Impacts Catalog
- Storm Surge
- Virtual Laboratory (VLab)
- AWIPS applications

Current Capabilities
FY14 Accomplishments and FY15 Plans

- National Blend of Models

- Model Output Statistics (MOS)

- Localized Aviation MOS Program (LAMP)

- Storm Surge

- National Digital Forecast Database (NDFD)

- Impacts Catalog

- Virtual Laboratory (VLab)

- Rip Current

National Blend of Models
A Sandy Supplemental Gap Mitigation Project

Goal: Develop a nationally consistent set of gridded guidance products for NDFD weather elements based on available model data (NWS and non-NWS), verification, and bias correction techniques while leveraging national computing power.

Phase I: Produce deterministic grids for the Day 3-8 time frame:
- Temp, Dewpoint, Max/Min Temperature, Sky Cover, Wind, 12-H PoP
- Produced 2x/day: 0000 and 1200 UTC
- Global models (deterministic and ensemble)

Later Phases: Extend to a full set of NWS Deterministic and probabilistic products covering days 1-10.
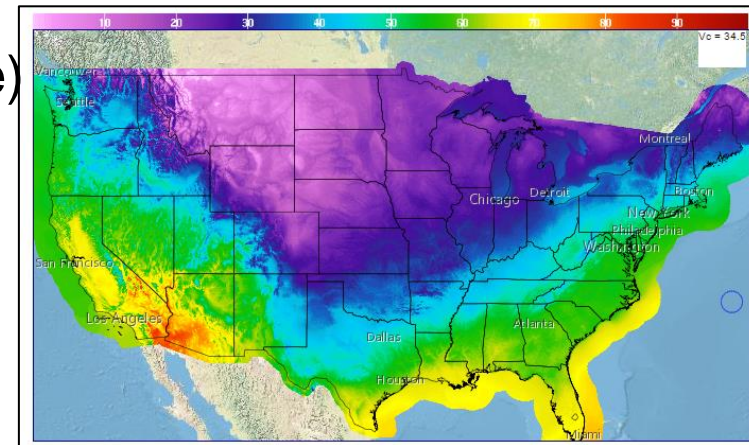
National Blend of Models

FY14 Accomplishments

- National Blend project scope finalized

- Completed sample-size sensitivity studies to determine optimal balance between computing resources and training data for post-processing. Results published in Reforecast White Paper, Hamill et al.

- Preliminary Blend Products (T, Td) available for evaluation in MDL's viewer

FY15 Plans

- Complete transition of 12-H PoP from OAR development to MDL implementation

- Add additional elements: Winds, Sky Cover, Max/Min Temperature

- Begin work on OCONUS domains, starting with Alaska

- Prototype Blended guidance ready for evaluation

National Blend of Models
Verification
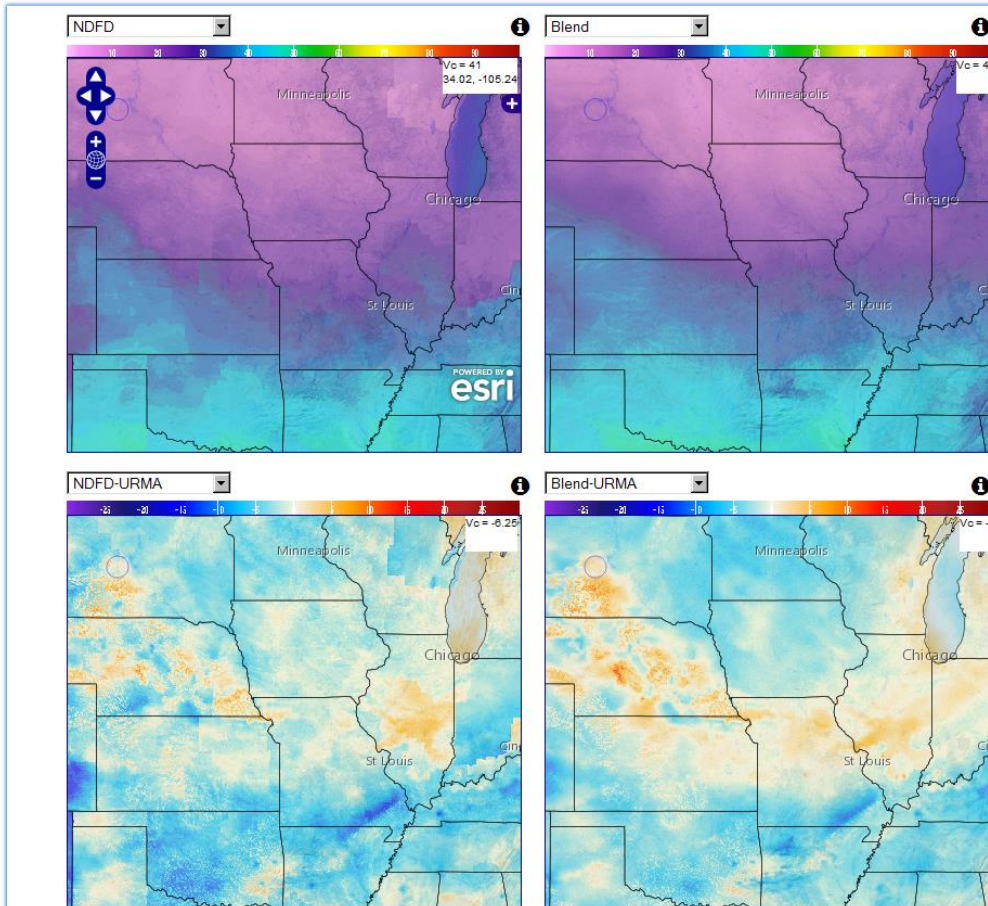
OpenLayers Viewer developed to:
- Compare candidate analyses
- Evaluate parallel URMAs
- Evaluate prototype Blend grids alongside NDFD/WPC/GMOS
- Provide verification of prototype Blend grids

Coming soon:
- Additional elements
- Improved image labeling
- Blend forecast point layer

Monthly grid and point scores for the blend will be added to the MDL monthly NDFD verification soon

Provide comments via Blender page on VLab

http://www.mdl.nws.noaa.gov/~blend/blender.prototype.php

Model Output Statistics (MOS)

MOS is statistically calibrated objective guidance products from numerical weather prediction models for weather elements contained in public and aviation forecasts.

Goal: Develop new techniques for generating objective guidance with emphasis on probabilistic and high-resolution gridded guidance.

Model Output Statistics (MOS)

FY14 Accomplishments

- Addition of predominant weather and precipitation type to GFS-based gridded MOS product suites for CONUS and Alaska

- Added ECMWF station-based deterministic and ensemble MOS into NCO's "quasi-production" job stream

- Performed evaluations of parallel NAM and GFS model data to assess impact on the MOS guidance

FY15 Plans

- Refresh of GFS MOS station guidance for the *cool season* in response to GFS model upgrade

- Refresh of GFS MOS station guidance for the *warm season* in response to GFS model upgrade

- Extend GFS-based gridded MOS forecasts for CONUS and Alaska to day 10 (may be bundled with warm season MOS implementation)

- Implement station-based ECMWF MOS into the NCEP production suite
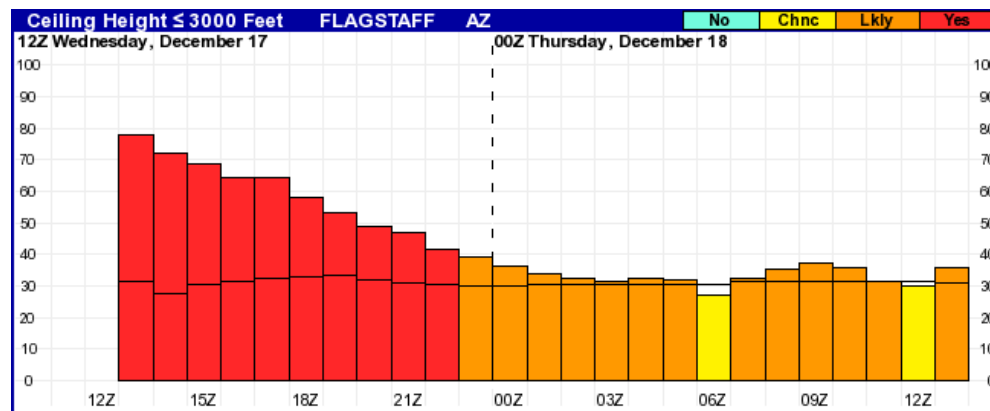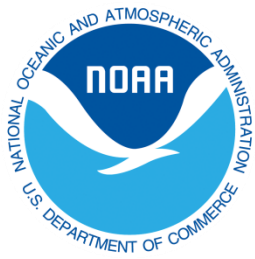
Localized Aviation MOS Program (LAMP)

LAMP provides hourly updates of MOS forecasts at stations and on grids from 1-25 hours by utilizing the latest observational data (METAR, lightning, radar), MOS forecasts, output from simple advective models, and geo-climatic data (hi-res topography and relative frequencies).

Goal: Improve on MOS forecasts and persistence out to 25 hours through rapid infusion of current observational data.
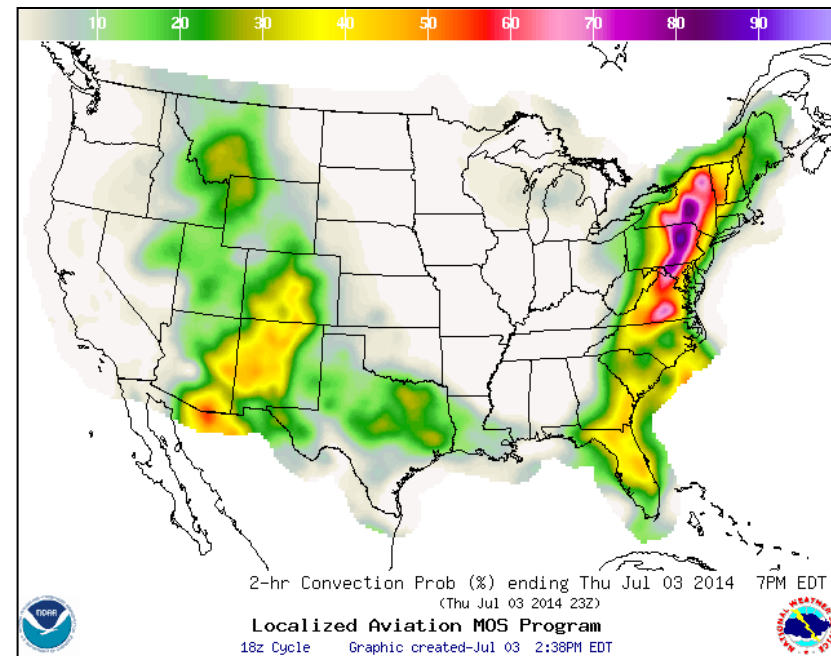
Localized Aviation
MOS Program (LAMP)

FY14 Accomplishments

- New LAMP convection and upgraded lightning guidance was implemented into NWS operations
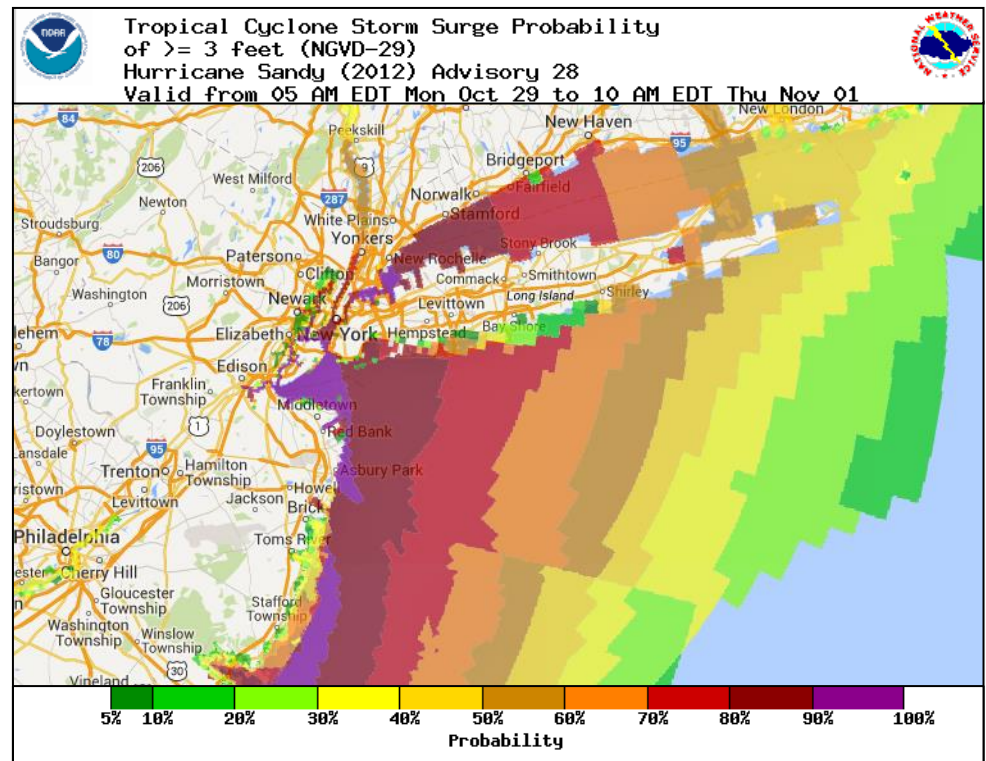- The guidance is produced hourly, is on the 2.5-km NDFD grid

FY15 Plans

- Improved Gridded Ceiling Height and Visibility using HRRR model
- Improved Temperature and Dewpoint
- Addition of Winds and Sky cover
- Improved Convection and Lightning
- Using MRMS radar data and Total Lightning data
- Higher temporal resolution: 1 hour periods for the very short-range period (0-6hrs or 0-8hrs)
- Longer temporal extent: 2 hour periods for the 1-36h period

Storm Surge

SLOSH model is used as basis of real-time storm surge forecasts when a hurricane is threatening. Simulation studies are provided to assist in the "hazards analysis" portion of hurricane evacuation planning by FEMA, U.S. Army Corps of Engineers, and state and local emergency managers.

Goal: Develop and improve techniques for producing forecasts for the coastal marine environment, including tropical and extratropical storm surge.

Tropical Cyclone Storm Surge Probability of >= 3 feet (NGVD-29)
Hurricane Sandy (2012) Advisory 28
Valid from 05 AM EDT Mon Oct 29 to 10 AM EDT Thu Nov 01

Storm Surge

FY14 Accomplishments

- Incorporate tides in each ensemble member

- Provide above ground level guidance

- Provide 6-hr temporal (e.g. 0-6, 0-12, 0-18, … 0-78 hour and 0-6, 6-12, 12-18, … 72-78 hour) guidance with the AGL products

- Output to the 2.5-km NDFD CONUS and 3 km NDFD Alaska grids

FY15 Plans

- Increase temporal resolution of the "incremental exceedance above datum" products from 6-hourly to 1-hourly

- Nest coarse extra-tropical basins with fine scale tropical basins for the East Coast and Gulf of Mexico

- Operationalize post processing methods for computing total water level at stations and provide the result to AWIPS/AHPS via SHEF messages

- Create basin(s) with overland information which cover both the Bering Sea and Arctic
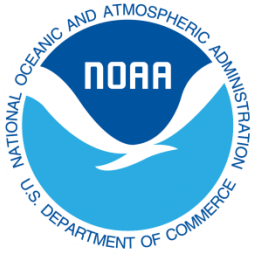
National Digital Forecast Database (NDFD)

NDFD is a seamless mosaic of digital forecasts from NWS field offices working in collaboration with the National Centers for Env. Prediction (NCEP).

Goal: Provide products and geospatial data services that provide maximum flexibility to customers and partners.
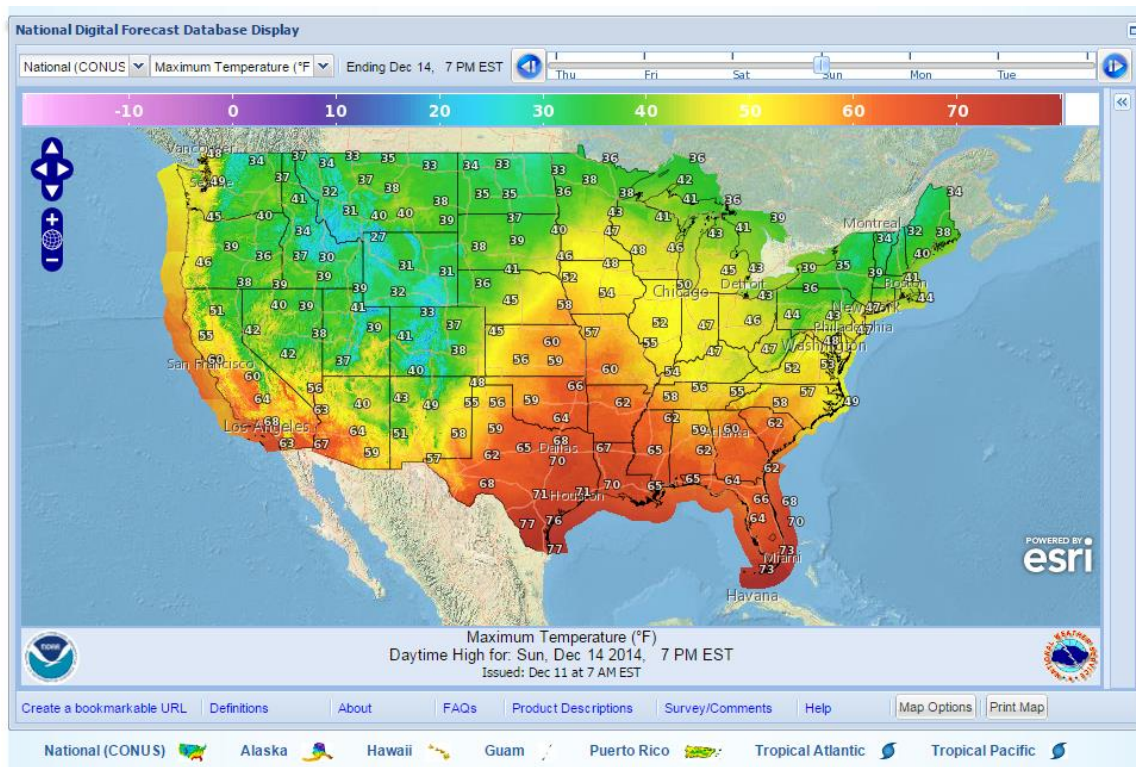
National Digital Forecast Database (NDFD)

FY14 Accomplishments

- Upgraded NDFD input to Great Lakes Wave Model (GLWM) to 2.5-km and streamlined delivery of mosaics to EMC

- Increased temporal resolution from 6-h to 3-h for day 1-3 forecasts in the NDFD oceanic domain

- Implemented GMOS default for NDFD Weather grids when WFOs fail to provide day 7 forecasts

- Transitioned full-resolution CONUS grids (1-h resolution at 2.5-km) from experimental to operational status
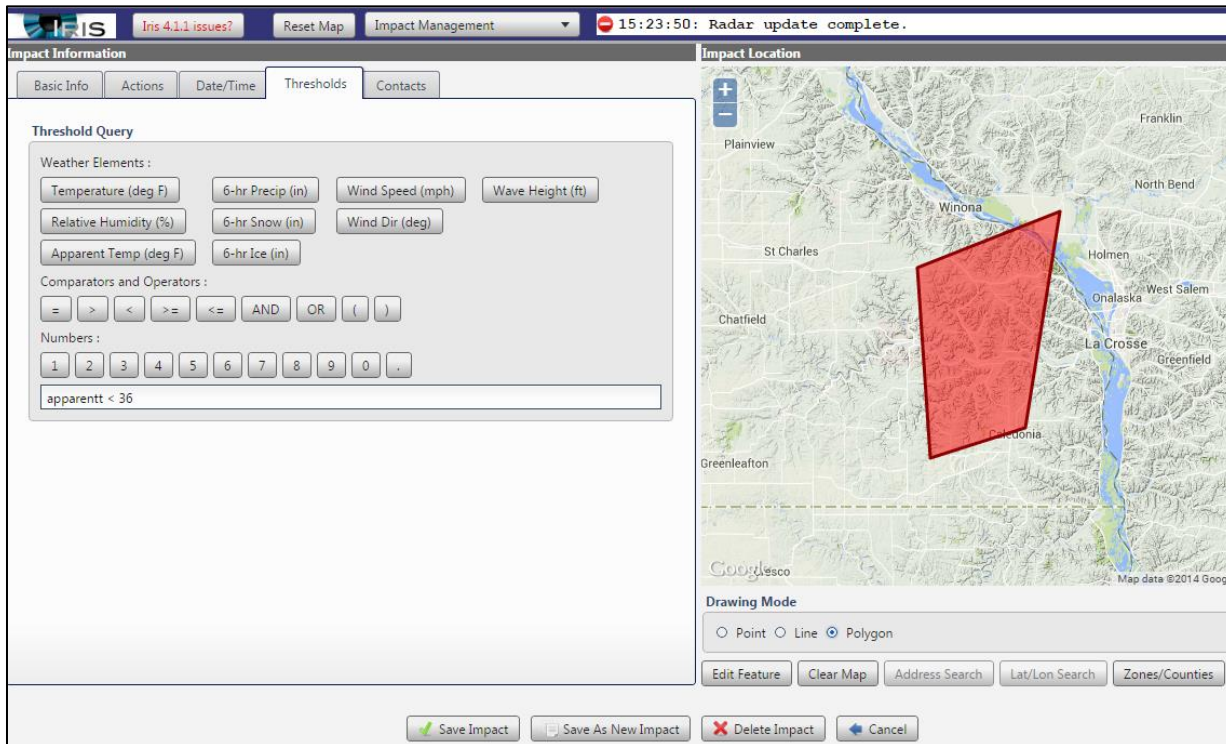
FY15 Plans

- Move experimental NDFD map viewer into NIDS production environment

- Make Haines Index (for Fire Wx) mosaic of EMC and WFO grids available via NDFD

- Make 2.5-km NDFD available via SOAP/XML

- Migrate NDFD hardware to AWIPS system baseline

Impacts Catalog

Impacts Catalog is a centralized database of known societal impacts of climate, water, and weather dependent events.

Goal: Allow the NWS to support data-driven decision making in the provision of IDSS and the issuance of hazards products.

Impacts Catalog

FY14 Accomplishments

- Completed Requirements Definition
- Completed OT&E of Impacts Catalog Prototype Version

FY15 Plans

- Stand-by migration of Iris/iNWS/Impacts Catalog to IDP in FY15
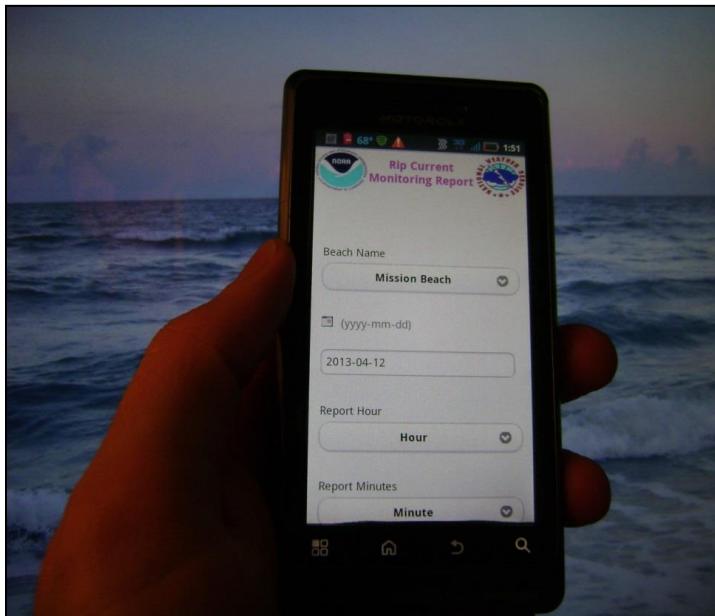- OT&E of Impacts Catalog Beta Version

Rip Current Monitoring and Prediction

Rip Current Monitoring receives and analyzes of rip current observations from lifeguards to provide validation for national and local rip current models.

Goal: Enhance situational awareness of surf zone conditions for participating forecast offices.

Rip Current Monitoring and Prediction

FY14 Accomplishments

- Implemented web form to support the collection and storing of lifeguard observations of rip currents and surf zone conditions in support of new NWS-United States Lifeguard Association MOU

FY15 Plans

- Plan MDL-NOS-EMC feasibility/validation study of NOS (Dusek) rip current forecasting scheme
- Migrate MDL lifeguard rip current observation system to Liferay-based framework to support rehosting on IDP

NOAA Virtual Laboratory (VLab)

VLab is a set of services and IT framework which enables collaboration, software development, applied research, and project management.

Goal: To manage innovation, streamline O2R, and accelerate R2O in NOAA.

NOAA VLab

FY14 Accomplishments

- Implemented AWIPS Distributed CM within VLab
- Implemented Google Analytics for VLab
- Established VLab User Support Desk
- More than doubled number of VLab Users, Projects, and Communities

FY15 Plans

- Complete migration to IDP on December 5
- Upgrade VLab Collaboration Services to LIFERAY 6.2 EE
- Implement Project Repository – Ideas Marketplace
- Establish linkage to NOAA R&D Project Database
- Support development of Central Region SOO Communities
- Implement Google Open ID Single Sign-On
- Begin planning/design for Central Development and Testing Environment

MDL Strategic Vision and Long-Term Plans

- Strategic Perspective
  - How MDL fits under DOC, NOAA and NWS' Weather-Ready Nation

- MDL's new 5-year Strategic Plan
  - Vision
  - Strategic Goals
  - Objectives and Strategies

Strategic Perspective
NWS and MDL Evolution

- NWS is undergoing fundamental change to meet the challenges of building a Weather-Ready Nation (WRN)

- MDL needs to evolve along with the NWS to meet the emerging challenges of the future
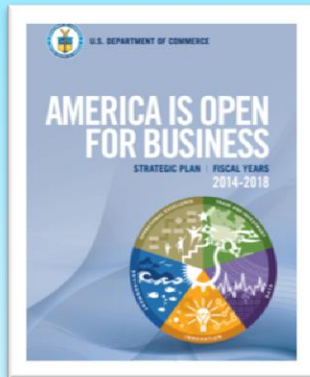
- Drivers to initiate new strategic direction
  - WRN Roadmap 2.0
  - New NWS budget structure
  - NWS HQ reorganization

Strategic Perspective
Plans of Parent Organizations

DOC Strategic Plan
Strategic Objective 3.2

Improve preparedness, response, and recovery from weather and water events by building a Weather-Ready Nation
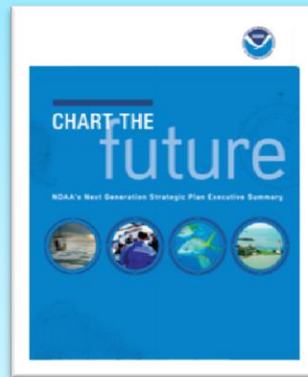
NOAA Strategic Plan
Long Term Goal: Weather-Ready Nation

Society is prepared for and responds to weather-related events
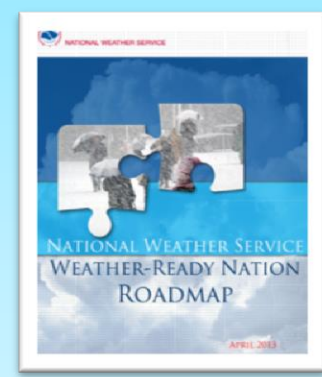
NWS Strategic Plan & NWS Weather-Ready Nation (WRN) Roadmap

Sets NWS priorities

MDL Strategic Plan
4 Goals directed toward leading the NWS in the application of meteorological science and technology to improve weather services
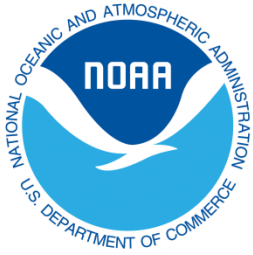
Strategic Perspective
MDL's Roles for WRN Goals

- The NWS will shift to providing additional Impact-based Decision Support Services (IDSS)

- Requires expanded and optimized use of probabilistic forecast guidance

- MDL makes important contributions by
  – Providing foundational datasets
  – Developing innovative guidance products
  – Infusing of scientific and technical achievements into ops

MDL Strategic Plan
Vision

To help NWS achieve its vision outlined in the WRN Roadmap, MDL has set a new vision to plot our way forward:

MDL: The ***essential partner*** in the NWS for ***collaborative development*** and ***transition of Research to Operations (R2O)*** for
- meteorological forecast applications,
- interpretive model guidance, and
- digital forecast services
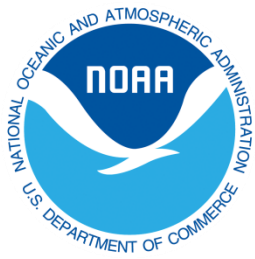
MDL Strategic Plan
Goals

- **People:** Sustain a workforce of experts in MDL's core competencies that are dedicated to advancing the NWS mission

- **Science and Technology:** Develop and facilitate the transition of critical and emerging science and technologies in support of a Weather-Ready Nation

- **Infrastructure:** Evolve hardware and software to meet current and future demands

- **Collaboration:** Foster engagement with our development partners and customers to ensure the value, usability, and relevance of MDL products and services

MDL's Strategic Goals:
People

Objectives

- Recruit, retain, and develop a highly-skilled and competent workforce

- Build a sustainable critical mass of expertise through a robust system for knowledge transfer and succession planning

Strategies

- MDL Adjunct Program + National SOO program via STI

- Short-term exchange programs
  - *Forecaster Exchange?*

- Rotational assignments

- Recruitment of students

- Training!!!

MDL's *people* are our *#1 resource*. We must add focus on *recruitment* to gain needed new skills, while retaining focus on current workforce through *training* and adequate *resources.*

MDL's Strategic Goals
Science and Technology

Objectives

- Improve **quality** and **resolution** of our existing products
- Development in **new/emerging areas** in support of WRN goals
- Transform our processes to be more **efficient**
- Enhance **R2O** through continued improvement of VLab

Strategies

- Evolve **statistical post processing** working NWS & NOAA partners
  - Better exploitation of **ensembles**
  - Integrate **emerging statistical techniques** into MOS products
- Leverage **HRRR** for improving MOS and LAMP guidance
- Collaboratively improve **VLab ease of use** of with field users/developers
- **IDSS**: Impacts Catalog, FACETs
- Improve **National Blend of Models**

MDL will exploit **new/improved S&T** to meet **emerging needs**, while also improving our legacy capabilities.

MDL's Strategic Goals:
Infrastructure

Objectives

- ***Enhance the ability of users*** to exploit MDL's capabilities to execute their mission

- Leverage ***external computing resources***

- Meet future demands by ***modernizing*** hardware/ software infrastructure and web presence

Strategies

- Explore ***community solutions*** for statistical post-proc. and verification
  - Modernize/replace MOS-2000

- Migration to ***industry standards***
  - Std. data formats (GriB, BUFR, etc.)
  - Open Geospatial Consortium (OGC)

- Migrate MDL devel. systems to NCEP

- Greater integration with ***AWIPS-2*** development (VLab, etc.)

- Better exploit ***GIS*** capabilities

- Continued devel. of ***NDFD/NDGD***

MDL must ***modernize*** our hardware/software infrastructure to meet ***new challenges*** and improve user/partner capabilities.

MDL's Strategic Goals:
Collaboration

Objectives

- *Anticipate* and address evolving partner/customer *requirements*

- Expand *collaborative development* with partners
  - *R&D component of Integrated Field Structure*

- Improve *engagement* with NWS field offices to foster better *mutual understanding* of *field needs* and *MDL capabilities*

Strategies

- Increase engagement with *NWS field users/developers* to foster better *2-way understanding* of field needs and MDL capabilities

- Increase involvement with *Testbeds* and *Proving Grounds*

- Greater integration with *NCEP*

- Better strategic alignment with *NCEP* and *NOAA Labs*

Accelerate evolution from developing/maintaining our own capabilities to Lab that focuses more on *collaborative development* and *R2O transitions*

Conclusions

- MDL will build upon our 50-year TDL/MDL legacy to meet emerging challenges towards a Weather Ready Nation

- In so doing, MDL will focus on our People, Science & Technology, Infrastructure and Collaboration in order to achieve our vision:

To be the ***essential partner*** in NWS for ***collaborative development*** and ***transition of (R2O)***